APPENDIX B

SCOPE OF WORK (SOW) OUTLINE FOR A SOLIDIFICATION/STABILIZATION TREATABILITY STUDY

NOTE: USING THIS APPENDIX. This outline is supplemented by text describing the typical requirements for each outline topic. This explanatory text is separated from the outline contents by rows of asterisks. This text is for the benefit of the personnel determining scoping requirements.

1. Project Overview and Objectives.

1.1. Site Background.

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This section should describe past uses and disposal practices at the site and how these activities have led to the existing contamination. Also discuss operations outside the site that may have contributed to the contamination when describing site usage.
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1.2. Existing Site Conditions.

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Provide a description of all pertinent (hydrologic, geologic, etc.) site conditions. Discuss the areas of the site which are contaminated including the levels and ranges of contamination found during previous investigations. Also note the estimated quantity of contaminated material. All pertinent soil borings, geotechnical test results and chemical test results should be included in the appendices. Indicate the detail to which the site has been characterized and note any obvious data gaps that exist.
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1.3. References.

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Reference EPA guidance documents, previous treatability studies, and any project documents which could be beneficial to the Contractor. Those documents which will be provided to the Contractor should be noted.
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1.4. Regulatory Authority.

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Reference the regulatory program under which the treatability study is being performed (i.e. CERCLA/SARA, National Contingency Plan, any IAGs, Federal Facilities agreements, state regulatory criteria, etc.). This paragraph should also indicate that sample collection and testing should be carried out in accordance with the treatability study exemption requirements as described in 40 CFR 261.4 (e) and (f).
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1.5. Objectives of Treatability Study.

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List the chemical and physical criteria which the treated material must achieve. Specific test methods and procedures are discussed in later sections of the scope of work. Shown below is an example list of criteria. The listed values are shown only as examples and should not be considered complete. Actual chemical and physical criteria should be determined on a site specific basis in accordance with the Record of Decision, regulatory criteria, or a Memorandum of Agreement with the appropriate regulatory agencies.

CHEMICAL CRITERIA

Contaminant	Max. All. Conc.
Arsenic	5.0 mg/L
Barium	100.0 mg/L
Cadmium	1.0 mg/L
Chromium	5.0 mg/L
Lead	5.0 mg/L
Mercury	0.2 mg/L
Selenium	1.0 mg/L
Silver	5.0 mg/L

PHYSICAL CRITERIA

Property	Pass/Fail Criteria
Unconfined Compressive Strength	≥50 psi
Free Liquid Content	No free liquid
Volume Increase	≤25% increase in volume
Hydraulic Conductivity	≤1 X 10^{-7} cm/sec
Wet/Dry Durability	Mass loss ≤ 30% after 12 cycles
Freeze/Thaw Durability	Mass loss ≤ 30% after 12 cycles

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1.6 Summary of Tasks.

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Provide a brief list of the tasks the Contractor must perform as part of the treatability study. Details of each task are presented in the following paragraphs.

Task 1 - Contractor Work Plan Preparation
Task 2 - Treatability Study Sample Collection
Task 3 - Initial Sample Characterization
Task 4 - Treatability Study Testing
Task 5 - Analyses, Data Assessment/Validation and Reporting
Task 6 - Treatability Study Report

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2. Project Requirements.

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This section should provide details of the specific tasks the Contractor will be required to perform.
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2.1 Task 1 Contractor Work Plan Preparation.

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The Contractor will be required to produce a Treatability Study Work Plan which should include attachments, if necessary, for a Site Safety and Health Plan (SSHP) and a Sampling and Analysis

Plan (SAP). This section should indicate the Contractor will be expected to discuss each of the pertinent topics covered in the SOW.
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2.2. Task 2 Treatability Study Sample Collection.

****
The SOW should contain information describing the physical and chemical parameters of the samples to be collected. This section should also contain specifications as to the location, number, and quantity of samples to be collected. Sufficient sample should be collected to ensure all treatability study testing can be completed. Alternatively, the Contractor could be tasked to identify locations and numbers of samples to be collected. Representative samples should be collected for each distinctive type of contaminated material. Consideration should be given to whether the samples should represent worst case or average case conditions. Additional information on scoping requirements for sample collection is included in EM 200-1-3.
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2.3 Task 3 Initial Sample Characterization.

2.3.1 Homogenization of Raw Waste Materials.

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Treatability study samples should be homogenized to ensure testing is performed on samples with uniform properties. The Contractor's work plan should specify the method to be used to homogenize the samples. Particle size reduction may also be required if oversize material is present. The work plan should discuss how the homogenized samples will be subdivided for replicate testing.
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2.3.2 Chemical Testing.

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This section should outline what initial chemical testing will be performed. Leaching and/or total chemical analyses should be performed to verify that the level and types of contamination in the homogenized samples are representative of site conditions. This data will also be used to establish a baseline for comparison with the treated samples.
****

2.3.3 Physical Testing.

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This section should outline what initial physical testing will be performed. A sufficient number of classification tests should be performed on the homogenized samples to verify that properties such as moisture content, gradation, and Atterberg limits are representative of site conditions. The samples should also be visually characterized for parameters such as texture and cohesiveness.
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2.4 Task 4 Treatability Study Testing.

2.4.1 Reagents.

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The Contractor should be tasked to identify what reagents will be tested during the treatability study. The selection process should utilize the Contractor's past experience as well as literature searches. Reagents should be selected for the treatability study based on effectiveness, cost, and proximity to the project. The Contractor's work plan should document how each of the selected reagents will react with the contaminants present to reduce their mobility.

In some instances, the designer may have enough experience to allow the Government to specify reagents that will be used during the treatability study. If this is the case, these reagents should be identified in the SOW.
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2.4.2 Testing Program.

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A typical treatability study testing program will be an iterative process which determines the optimal formulation that achieves the project objectives. The testing program should emulate expected conditions and processes to be used during remedial action to the greatest extent possible. The Contractor should be tasked to propose a testing program which consists of mixing small volumes of contaminated material with several reagents at varying waste/reagent/water mix ratios. The mixtures should be allowed to cure and then be evaluated according to established physical and chemical criteria. Formulations that produce favorable results will undergo additional testing. The Contractor's testing program should consist of a minimum of two rounds of testing to improve and refine the formulation. The final recommended mix design will be the one that most

economically achieves the chemical and physical test objectives established for the project.

The amount of replicate testing should be proposed by the Contractor for each phase of the treatability study. Sample preparation procedures, curing methods, and curing times should also be proposed by the Contractor.

Paragraphs 2.4.3 and 2.4.4 require the Contractor to propose the sequence of testing and test methods to be used during the treatability study. Depending on the experience of the designer, some parts or all of these sections may be specified by the designer. In cases where the designer specifies the sequence of testing and test procedures, the Contractor should be given the opportunity to suggest modifications to the testing program based on past experience.
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2.4.3 Initial Mixing and Testing.

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The Contractor should be tasked with identifying what waste/reagent/water mix ratios will be evaluated in the initial round of testing. The objective of the initial round is to determine what reagents provide the best performance. These tests are screening tools to help formulate and refine what final mixes will be tested. The Contractor should outline the number and type of tests to be performed, sample preparation procedures, curing methods, curing times, and the number of replicate samples.

After completion of initial mixing and testing, the Contractor is sometimes required to submit a report to the Government which summarizes all data collected during the initial mixing and testing phase of the treatability study. Where applicable, ASTM or EPA reporting requirements should be used. Otherwise, raw data should be reported in tabular or graphic form. The Contractor should include a recommendation for reagents and waste/reagent/water ratios to be tested during the final mixing and testing phase. After review and approval, the Government will issue a written order to the Contractor to proceed with final mixing and testing.
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2.4.4 Final Mixing and Testing.

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The Contractor should estimate the anticipated number of mix ratios to be tested during the final round of testing. The Contractor should also outline the number and type of tests to be performed, sample preparation procedures, curing methods, curing times, and the number of replicate samples.
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2.5 Task 5 Analyses, Data Assessment/Validation, and Reporting.

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A SAP should be prepared as an attachment to the Treatability Study Work Plan. EM 200-1-3 should be referenced for guidance in preparation of the SAP.
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2.5.1 Analytical Procedures.

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The following sections of the SOW outline specific analytical protocols to be followed for the treatability study. The project design engineer and chemist should generate tables summarizing this information. The Contractor will include this information in the SAP.

Before developing this section of the SOW, the project chemist must determine what methods will be required to determine the contaminants of interest (i.e., metals, PCBs, volatiles), what detection limits are needed (percent, ppm, ppb), and what matrix types will be sampled for the treatability study. Factors to be considered in selecting an analytical method include applicable regulatory requirements (the magnitude of an action level and the detection limit must be considered), specificity, sensitivity, variability, accuracy, cost, necessary equipment, time, skill level, quality control, and required documentation.

The project chemist should specify analytical procedures as needed from EPA's SW-846 or other standard methods compendium. This section specifically identifies the criteria for each analysis on a matrix-specific basis.

The rationale for SOW instructions on analytical procedures must be included in this section. Data quality objectives (DQOs) will be clearly defined to include a discussion of how analytical data will be used to answer project specific questions. Quantifiable limits will be established for Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC) parameters plus sensitivity to ensure analytical data of sufficient quality to support the DQO decision process.

The Contractor should be responsible for reviewing this section of the SOW and adding input to assure the goals of the treatability study will be met. The Contractor should include standard test procedures (ASTM, EPA, etc.) with all recommendations for testing. Procedures should be described for all tests which do not have formalized procedures. The project chemist and technical staff must carefully review these Contractor suggestions. Non-standard test procedures should be approved by the Government prior to use. These procedures may require analysis of several samples to determine if the method is repeatable, precise and accurate.

The SAP must be provided to the contract laboratory as well as the QA laboratory along with the listing of DQOs. The method of funding the QA laboratory must be considered at the scope of work stage of the treatability study process to ensure funds will be provided so the QA laboratory can complete the work without delays due to funding.
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2.5.2 Field Screening.

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This section should define field screening methods to be used in the process of collecting samples for the treatability study. The project chemist and geologist should propose acceptable methods to the Contractor. The Contractor may also be given latitude to propose field screening methods. The Contractor should summarize all field screening in the SAP for review and approval.
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2.5.3 Sample Handling.

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To assure that shipping of samples does not result in physical, chemical, or biological alterations, the project chemist should instruct the Contractor as to sample handling protocols which are acceptable for the treatability study. The following specific information should be included in the SAP: sample containers, sample labeling, sample preservation, packaging, shipping procedures, and chain of custody procedures. EM 200-1-3 contains chemistry technical requirements for these topics.
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2.5.4 Preservatives and Holding Times.

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The project chemist must specify preservatives and holding times that will be contractually required for the treatability study. A table should be prepared for insertion into the SOW clearly outlining each analytical protocol with this information. The Contractor must summarize this information in the SAP. The Contractor should be made aware that violation of either sample preservation protocol or holding times may result in liability for resampling, since either condition may result in samples which are not representative of field conditions. The work plan should discuss sample storage during the treatability study.
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2.5.5 Quality Assurance/Quality Control (QA/QC).

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This section of the SOW should state the specific QA/QC requirements for chemical testing. To assure data will be of suitable accuracy to meet the project objectives, the QA/QC requirements should be based on input from the project chemist, design engineer, geologist, and technical manager. The SOW should provide this information in a tabular form. The Contractor must include this information in the SAP.
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2.5.5.1 QA Laboratory.

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In this section, the project chemist should specify which USACE laboratory will be the QA laboratory for the project. If a QA laboratory is deemed unnecessary by the chemist, delete this section. If using external QA, state that the Contractor is responsible for sending field generated QA samples to the specified laboratory. The project chemist should generate a table summarizing the number of QA samples to be sent to the QA laboratory. The Contractor should include this in the SAP. The project chemist should also summarize any requirements on notifying the QA laboratory prior to shipment of samples. Typically, the QA laboratory should be notified at least 2 days in advance of shipping.
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2.5.5.2 QC Samples.

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This section should contain specifications as to the type and number of QC samples to be generated. The Contractor should include this information in the SAP.
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2.5.6 Laboratory Turnaround Time.

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This section should include specifications from the chemist as to the turnaround time required for completed data reports to be generated from the laboratory. The Contractor will include this in the SAP.

The project chemist should consult with the users of the data to determine whether expedited reporting is necessary. The usual turnaround time for reporting data to a customer from a contract laboratory is approximately 30 days. The usual turnaround time for reporting data to a customer from a QA laboratory is approximately 30-45 days. An additional fee is usually attached per sample when expedited turnaround times are specified in a SOW.
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2.5.7 Off-gas Emission Air Samples.

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The off-gas emission of hazardous substances during a site remediation utilizing the S/S process may pose health risks to site workers and to the nearby public. Therefore, monitoring of emissions released during the mixing and testing phases of the treatability study may need to be performed. Measurement of off-gas may help verify if contaminants will be released during full-scale S/S treatment. However, off-gas emission measurement is difficult. Often times measurement of off-gas emissions involves little more than holding a photo ionization detector above the sample. Factors such as height above the sample, temperature of the sample, and airflow will affect the results. If measurement of off-gas emissions is critical, testing should be performed in an enclosed specifically designed vessel. The Contractor should propose emissions monitoring/sampling techniques sufficient to characterize any off-gassing potential of the waste.
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2.5.8 Investigative-Derived Wastes (IDW).

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The project chemist and geologist will need to estimate the approximate volumes and types of IDW that will be generated during the treatability study. Types of IDW that could be generated include the following:

- -Soil cuttings
- -Personnel protective equipment (PPE)
- -Disposable equipment (DE)

-Cleaning/decontamination fluids
-Laboratory IDW.

All laboratories performing work to support the treatability study must be instructed whether to ship samples back to the site after testing for future handling with the bulk wastes or to dispose of them appropriately. If the latter is implemented, the Contractor should describe how samples will be characterized and disposed.

The project chemist should include instructions in the SOW on how IDW from field work will be handled. If the Contractor will be required to characterize and dispose of these wastes, he should be tasked to propose a waste handling plan which describes how wastes generated during sample collection will be characterized and disposed.

If RCRA Hazardous IDW is to be stored on-site, contact the State RCRA regulators to determine storage requirements. In most instances, the state will require that IDW be stored in accordance with the storage provisions of RCRA for generators which are found in 40 CFR 262 and 40 CFR 264.

See EPA Guidance Document EPA/540/G-91/009, Management of Investigation Derived Wastes During Site Inspections, May 1991, for additional information on this topic.
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2.6 Task 6 Treatability Study Reports.

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Provide details on content and format of all treatability study reports the Contractor must generate.
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2.6.1 Chemical Data (Interim) Report.

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If QA testing is performed, a chemical data (interim) report deliverable will be submitted to the QA laboratory for comparison between the data generated from the Contractor's QC and the USACE QA laboratories. This deliverable should contain, at a minimum, all chain of custody forms and those items outlined within the 16 August 89 memorandum entitled "Minimum Chemistry Data Reporting Requirements for DERP and Superfund HTW Projects."
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2.6.2 Treatability Study Reports.

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This section should specify requirements for treatability study reports. Typically the Contractor is required to prepare a draft and final report. The Contractor should be required to discuss the organization and content of draft and final reports. The following can be provided as a suggested outline for treatability study reports:

1.0 Introduction
- 1.1 Purpose of Study
- 1.2 Organization of Study
- 1.3 Schedule

2.0 Background
- 2.1 Project Background and Site History
- 2.2 Available Data and Assumptions
- 2.3 Reagent Selection Process
- 2.4 Standard Test Procedures

3.0 Sample Collection and Handling
- 3.1 Selection of Sampling Locations
- 3.2 Site Sampling and Handling

4.0 Initial Sample Characterization
- 4.1 Chemical Test Results
- 4.2 Physical Test Results

5.0 Testing Program
- 5.1 Sample Preparation and Curing
- 5.2 Initial Mix Ratio Selection
- 5.3 Initial Mixing and Testing
- 5.4 Chemical and Physical Test Results
- 5.5 Final Mix Ratio Selection
- 5.6 Final Mixing and Testing
- 5.7 Chemical and Physical Test Results
- 5.8 Off-Gas Testing

6.0 Conclusions
- 6.1 Optimized Mix Ratios

Appendices:
- Appendix A Chain of Custody Forms
- Appendix B Physical Test Results
- Appendix C Chemical Test Results

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3. Project Management.

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This section describes requirements relevant to project management such as schedules, submittals, and points of contact.
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3.1 Project Manager.

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Require the Contractor to identify a single project manager. The Contractor should also identify personnel who will have key roles in performing the treatability study. The Contractor should not be allowed to change project manager or major team members without approval of the USACE project manager.
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3.2 Conference Notes.

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The Contractor should be required to submit notes for conferences and meetings that they attend in reference to the treatability study. Identify distribution requirements for the conference notes.
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3.3 Confirmation Notices.

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The Contractor should be required to provide records of all telephone conversations, verbal directions, etc., participated in by the Contractor on matters relevant to the treatability study.
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3.4 Government Support.

****
Clearly identify to the Contractor what will and will not be provided as support from the Government. Examples of Government support that may be provided include such things as permits, utility clearances, and rights of entry.
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3.5 Travel and Meetings.

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The number and type of meetings should be clearly identified in this section. Any special requirements or type of disciplines

that are required for a specific meeting should be included in the scope.
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3.6 Schedule.

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The project manager should provide a required completion deadline for the treatability study. The Contractor should be required to develop a proposed schedule showing the completion date for sampling, each phase of testing, and submission of all draft and final reports.
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3.7 Submittals.

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The submittals expected during the treatability study are listed in this section. No technical requirements should be presented here. The number of copies, and who will receive the submittals should be specified. This listing should include POC name, title, address, telephone number, and facsimile number.
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3.7.1 Treatability Study Work Plan.

3.7.2 Results of Initial Mixing and Testing.

3.7.3 Draft Treatability Study Report.

3.7.4 Final Treatability Study Report.

4. Site Specific Safety and Health Plan (SSHP).

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In general, the Contractor performing a treatability study must comply with the requirements of 29 CFR 1910.120 while performing on-site work. Specifically, the Contractor shall develop, implement and enforce an SSHP which effectively addresses the hazards related to working in, around, and with contaminated material expected on-site during the collection of samples and any portion of the treatability study performed on-site. At a minimum, the SSHP should address the topics outlined in Appendix B of ER 385-1-92 in the detail necessary to assure that the on-site personnel are protected from hazards and potential exposure to the chemical contaminants expected.

When samples are sent to a laboratory for treatability study testing, all other applicable portions of OSHA General Industry Standards, 29 CFR 1910, shall be complied with for laboratory operations, including 29 CFR 1910.1450.

CEGS 01110 Safety, Health, and Emergency Response (HTRW/UST) contains language relating to qualifications for Safety and Health Professionals which may be adapted to the requirements for a specific treatability study.
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5. Geotechnical Requirements.

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This section presents requirements for performance of geotechnical activities.
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5.1 General Specifications.

5.1.1 Qualified Geologist/Geotechnical Engineer.

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This section specifies the minimum requirements for the experience, training, or registration/certification of the Contractor's project geologist and/or geotechnical engineer. The Contractor should be required to submit resumes for geologists or engineers involved in the treatability study in the work plan. In some cases, it may be necessary to require the use of a driller or surveyor licensed in the state in which the project is located.
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5.1.2 Decontamination of Equipment/Tools.

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This topic describes the acceptable procedures for decontamination of the sampling tools, drill rigs, backhoes, etc. This should be developed in consultation with the chemist and industrial hygienist. Decontamination fluids are considered investigation-derived wastes.
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5.1.3 Water Source and Testing.

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If water is required for site activities, such as rotary drilling, testing requirements should be described here. A chemist should assist in developing this portion of the scope if analyses of the water is required. If a source is available on site, this should be noted.
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5.1.4 Site Restoration and Protection.

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The Contractor is normally required under this section to restore the site after field work is completed. Any unusual site protection requirements such as protecting trees and wetlands should be discussed here.
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5.1.5 Site Surveying.

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If surveys are required, this section should describe the requirements for surveying of treatability study sampling locations. The survey data should be required to be compatible with data from previous site surveys.
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5.2 Subsurface Sampling.

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This section discusses the required procedures for drilling boreholes, excavating test pits, obtaining samples, and logging requirements.
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5.2.1 Drilling Method.

5.2.2 Test Pit Excavation.

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In some cases, sidewall sampling by personnel who enter the trench may be appropriate, but in other cases, sampling from the backhoe bucket may be adequate. The scope should require that sampling activities performed in or in close proximity to a trench be performed only after clearance by the site safety and health officer. Special consideration should be given to the

requirements of Section 23 "Excavation" and Section 27 "Work in Confined Spaces" of the USACE Safety and Health Requirements Manual, EM 385-1-1 (latest revision). In addition, the requirements of applicable OSHA standards, such as 1926.650 (Subpart P-Excavations) through 1926.652 (Requirements for Protective Systems) and 1910.120 (Hazardous Waste Operations and Emergency Response), should be met.
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5.2.3 Logging Requirements.

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Boring and trench logging requirements should be specified in this paragraph. EM 1110-1-4000 provides a summary of logging requirements.
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5.2.4 Sampling Techniques.

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This section describes the acceptable techniques for obtaining treatability study samples directly from the boring or pit. This section should be developed jointly by the geologist and the chemist. These requirements should be incorporated by the Contractor in preparation of the SAP.
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5.2.5 Hole Abandonment/Decommissioning.

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This section should discuss the acceptable method of abandoning a boring or trench. In some states, grouting of borings may be required, particularly if ground water is encountered. In other states, cuttings may be used for fill if they are clean. Coordination may be required with the federal and state regulatory authorities.
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5.3 Geotechnical Analyses.

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This section should list specific requirements for test procedures (ASTM, etc...) to be used for geotechnical testing performed during the treatability study. Test procedures should be listed for both characterization and treatability study testing. Any special testing requirements should be noted.
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